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## Relation of Study Factors to Performance in Navy Technical Schools

Josephine M. Randel, Ray E. Main,  
George E. Seymour, and Barbara A. Morris  
*Navy Personnel Research and Development Center*

This study was conducted to determine which study factors lead to success in Navy technical schools and to ascertain whether the effects of study factors vary from one school to another. Study factors refer to all clearly definable elements that may affect student learning and that may be influenced by training. A Study Factors Survey (SFS) was developed and administered to 1,762 students in seven Navy technical schools. Scores on high-failure tests (those failed by 10% or more of the students) were collected for the beginning, middle, and end of each course. Partial correlations between mean test scores and study factor scales were calculated, controlling for ability as measured by the Armed Services Vocational Aptitude Battery (ASVAB). Of 304 possible correlations, 87 were significant. Four study factors—Concentration, Competition, Memorization, and Motivation—had the greatest number of significant correlations with achievement scores. Anxiety and Mastery Beliefs had the next largest number of significant correlations.

Administrators and instructors of Navy "A" schools (the first technical school attended by Navy personnel) frequently find their students are deficient in required basic skills, such as reading, mathematics, and study factors. We define *study factors* as all clearly definable elements that affect learning and can be influenced by training. Study factors could include skills, strategies, or affective components. What we refer to as study factors have been previously discussed under several names such as study skills, learning strategies, and learning to learn.

Although standardized tests have been used to place students into remedial reading and mathematics programs, the Navy has no assessment

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Requests for reprints should be sent to Josephine M. Randel, Navy Personnel Research and Development Center, San Diego, CA 92152-6800.

tool to determine which study factors are most effective in technical training courses and which will pay off in higher test performance. The purposes of this research were to identify the study factors related to successful performance in Navy technical schools and to ascertain if different factors affect performance in different schools. Because this study deals with Navy electrical technology and electronics A schools, where there is a single course in a school, the terms *course* and *school* are used interchangeably.

Review articles in the 1960s and 1970s reported that study factors courses are effective in helping students improve their academic performance (Brozo, Schmelzer, & Thurber, 1982). High-risk and disadvantaged college students have also shown some improvement in academic achievement when enrolled in special programs that included study skills courses (Kulik, Kulik, & Shwalb, 1983). Weinstein and Underwood (1985) reported increased grade point average (GPA) and reading comprehension and reduced anxiety after a 3-credit semester course on learning strategies. Similar results were found for GPAs by Pintrich, McKeachie, and Lin (1987). Students who completed a 5-hr self-paced Air Force package on four study skills improved their test scores and completion times in a computer-managed technical training course (Dobrovolsky, McCombs, & Judd, 1980). Not all study factors training efforts have improved performance, however. A 4.5-hr training program for Army personnel was not successful (Weinstein, Rood, Roper, Underwood, & Wicker, 1980).

The success of study factors training depends on how appropriate the skills taught are for the school in which they are to be applied. Selection of appropriate study factors is particularly important for technical training environments, such as the Navy's, where training time is limited. Training in study factors would probably reduce the time available for teaching technical subject matter.

To identify the study factors appropriate for Navy technical training, we developed an instrument suitable for this population. We were interested in measuring some of the more traditional study factors such as note taking and test preparation, but we also wished to measure metacognitive skills such as elaboration and self-monitoring. *Metacognition* refers to learners' knowledge about and control over their cognitive processes (Wittrock, 1986). By using metacognitive processes, students strive to organize new material to be learned and to relate it to what they already know. Students also check for integration and understanding.

A search of the literature for an appropriate instrument for measuring the desired study factors uncovered no suitable test. Brozo et al. (1982) used the Minnesota Study Habits Bank to link specific study skills to academic performance at the college level. They found that successful and failing students can be differentiated by their use of some study skills. However,

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this questionnaire measured mainly traditional types of study skills such as scheduling, note taking, concentration, and motivation.

Most of the study factors instruments we reviewed covered these and other traditional study skills such as time management, work habits, and student attitudes toward school and study (Evans & Tribble, 1987; Nadson, Michael, & Michael, 1988; O'Neil & Child, 1984). A few included some of the cognitive or metacognitive learning strategies (Weinstein, Zimmerman, & Palmer, 1988). The Study Skills Questionnaire measures the metacognitive level, but it is not comprehensive and is impractical in that it requires each item to "be explained by the study instructor . . . because of its specialized vocabulary" (Bartlett & Knoblock, 1988, p. 364).

Two instruments that combine more traditional study skills and metacognitive skills are (a) the Learning and Study Strategies Inventory (Weinstein & Palmer, 1987) and (b) the Motivated Strategies for Learning Questionnaire (Pintrich, 1987). Both address a college population with a schedule of classes and requirements unlike those of Navy technical schools, and several of the questions were inappropriate for our population. For example, these questionnaires assume a student is taking general education and a variety of other courses as is common in college, rather than one course as is common in a military technical training school. The questionnaires also assume greater flexibility in planning study time than is possible for military students. Consequently, we decided to develop a tool to assess the study factors appropriate for military enlistees.

We conducted a literature search to select the most appropriate study factors for a technical school population. The selection of the study factors and development of the SFS questionnaire are described in detail in Seymour, Main, Randel, and Morris (1991). This article describes the application of the SFS to determine the relationship between study factor practices and test performance at seven Navy A schools.

The relative effects of study factor usage at different schools and at different course segments are of interest. Study factors may vary in importance from one school to another due to variations in course difficulty and type of content. All schools in our study teach electronics and electrical technology. Although these subjects are highly technical, the level of difficulty (as indicated by attrition) can vary greatly among schools (Main, Seymour, & Morris, 1989). A prerequisite for tailoring study skill preparation to individual schools is to determine school requirement similarities. In all of these schools, content varies over the length of the course. Initial sections typically deal with theory and mathematics, middle sections with basic circuits, and end sections with advanced circuit applications. Because study factors may vary in their relevance to different types of content, it was appropriate to determine whether relationships between study skill usage and test scores also varied among course sections.

## METHOD

## Subjects

A total of 1,762 enlisted students in seven Navy technical schools completed the SFS. These schools train students for occupations in the fields of electronics and electrical technology. The majority of students are high school graduates who range from 18 to 21 years in age.

## Materials

The SFS is a 16-factor, 98-item questionnaire with a four-choice Likert-type scale; scores on any item range from *almost never* (1) to *almost always* (4).

As a result of a reliability analysis, 12 of the 98 items were not used, leaving 86 items for this study. Each study factor has three to eight questions. For each study factor, a mean score was computed for each student by averaging the responses to the questions for that study factor. Reliability of the whole scale, as measured by coefficient alpha, is .92; reliability of the individual scales ranges from .59 to .90, all of which are significant. Alpha coefficients and the number of items in each scale are presented in Table 1.

TABLE 1  
Study Factors Survey Scales: Number of Items and Coefficient Alphas

<i>Study Factor</i>	<i>Number of Items</i>	<i>Alpha</i>
Anxiety	5	.712
Competition	3	.626
Concentration	7	.669
Elaboration	6	.731
Graphic Study Aids	3	.680
Group Study	5	.903
Mastery Beliefs	7	.585
Memorization	5	.632
Motivation	8	.732
Organization	8	.728
Questioning	3	.727
Review	5	.650
Self-Monitoring	8	.668
Study Resource Management	5	.716
Test Anticipation	5	.645
Test Strategy	3	.625

The study factors are defined as follows:

**Anxiety:** Generalized fear associated with learning or testing situations.

**Competition:** A tendency to compare one's performance with that of classmates or the perception of one's performance as being evaluated in comparison to others.

**Concentration:** The ability to focus on learning despite either internal or external distractions.

**Elaboration:** The tendency to relate new course information to what is already known or to other course information by use of representational strategies such as diagrams.

**Graphic Study Aids:** The use and understanding of charts, figures, and tables provided for study.

**Group Study:** The tendency to interact with other students to share ideas and information during study.

**Mastery Beliefs:** Attitudes relating academic achievement to personal effort.

**Memorization:** The ability to retain learned information and/or the use of memory techniques such as associations, repetition, or imaging.

**Motivation:** The level of drive or perceived incentive to complete training at this school or to learn assigned training content.

**Organization:** The ability or tendency to find or record key points in instructional presentations and relate them to each other.

**Questioning:** The process of seeking clarification in class from the instructor.

**Review:** The selective examination of previously read course material to enhance learning.

**Self-Monitoring:** The ability or tendency to check the accuracy of one's ideas or conclusions against related knowledge or criteria while gaining new information or processing data.

**Study Resource Management:** The tendency to allot adequate study time and to study in appropriate surroundings.

**Test Anticipation:** The tendency to try to anticipate test content.

**Test Strategy:** The use of techniques during a test to maximize the number of correct responses, such as skipping hard items or eliminating obviously incorrect answers from multiple-choice-type tests.

## Procedure

The failure rates for all written tests given by the seven Navy technical schools over a 6-month period were obtained from a Navy data base.

High-failure tests—those failed by 10% or more of the students—were selected for each course. Restricting our analysis to high-failure tests reduced the possibility of ceiling effects and prevented a restricted range of scores to correlate with the questionnaire results.

Each course was divided into beginning, middle, and end segments, and the high-failure tests were designated as belonging to one of these segments. For each course segment, available high-failure test scores were converted into standard scores and averaged to provide a combined segment score. Although we had planned to use three test scores per segment in obtaining combined scores, this was not always possible. For some segments, only one or two high-failure tests were available. For others, all test scores were not available for some students due to missing data in the data base. Use of tests with missing scores could reduce the sample size because subjects who did not have test data for all tests would be eliminated. Therefore, some high-failure tests with missing scores were eliminated from the study. As a result, one to three high-failure tests were used for each segment of each course with one exception. For School G, test data were available for the first segment only, and combined scores for the first segment were based on four high-failure tests.

Schools were instructed to administer the SFS to three groups of 100 students each. Each group was at a different segment of the course, and students were administered the SFS before they took any of the high-failure tests for that segment. In practice, the number of students administered the SFS for a course varied from 245 to 333 in each of six schools, with 92 students in one school (School G).

## RESULTS

In examining the effects of study factors on performance, there was concern that the effects of study factors might be confounded with student ability. Previous research reported a significant correlation between study habits and ability as measured by the Wonderlic intelligence test (Davou & McKelvie, 1984). Student ability, as measured by the ASVAB, is also known to be a good predictor of technical school performance. To control for the effect of ability, we obtained student scores on the ASVAB as a measure of ability. Because ASVAB scores were available for 1,533 of the 1,762 students in the sample, the total sample size was reduced. We calculated partial correlations between the mean score for each study factor on the SFS and the mean test score for each segment of each course, adjusting for the effect of ability as measured by the ASVAB. That is, the effect of ASVAB scores was partialled out. The results of the partial correlations between each study factor and performance (controlled for the

effect of ability) can be seen in Table 2 for the first segment of the course, Table 3 for the second segment of the course, and Table 4 for the third segment of the course. Schools A through F have data for three course segments, whereas School G has data for only the beginning segment.

A total of 87 significant correlations out of a possible 304 were obtained. The study factors showing the greatest number of significant correlations with achievement test scores were Concentration (13), followed by Competition and Memorization (10 each) and Motivation (9). Anxiety, Questioning, and Mastery Beliefs each had 6 significant correlations. The remaining study factors had 5 or fewer significant correlations.

The number of significant correlations per course segment was 41 for the beginning segment, 23 for the middle segment, and 18 for the end segment.

The number of significant correlations per school is shown in Table 5. School D has the largest number (14), followed by School C (11), School E (9), and Schools B and G (8 each).

## DISCUSSION

Of the 16 study factors chosen for study, the 4 with the largest number of significant correlations with achievement were Concentration, Competi-

TABLE 2  
Partial Correlations Between Study Factor Scales and School Performance for the First Segment of the Course

Study Factor	School						
	A	B	C	D	E	F	G
Anxiety	-.16*	-.31**	-.25**	-.10	-.28**	-.06	-.03
Competition	.09	.12*	.28**	.30**	.19*	.08	.27**
Concentration	.16*	.17**	.23*	.31**	.37**	-.05	.28**
Elaboration	-.05	.06	-.05	.17**	.11	.20*	.18*
Graphic Study Aids	-.07	.09	-.00	.15**	.04	.13	.18*
Group Study	-.13	-.09	-.11	-.13*	-.12	.01	.06
Mastery Beliefs	.07	.09	.05	.23**	.12	.31**	.10
Memorization	.08	.16**	.12	.27**	.23**	.28**	.43**
Motivation	.08	.08	.15	.31**	.17*	.22*	.28**
Organization	-.05	-.04	-.04	.19**	.08	.16	.21*
Questioning	-.03	.09	.08	.22**	.08	.17	.12
Review	-.02	.09	.02	.14*	.12	.15	.25**
Self-Monitoring	.06	.08	-.04	.21**	.17*	.11	.08
Study Resource Management	-.05	-.08	-.04	.11*	.04	.19*	-.07
Test Anticipation	.06	.06	-.10	.14*	.03	.16	.01
Test Strategy	-.07	-.17**	-.42**	.02	-.07	-.02	-.07

\* $p < .05$ . \*\* $p < .01$ .

TABLE 3  
Partial Correlations Between Study Factor Scales and School Performance for  
the Second Segment of the Course

Study Factor	School						
	A	B	C	D	E	F	G <sup>a</sup>
Anxiety	-.10	-.19**	-.04	-.02	-.15	-.27*	-
Competition	.18*	.11	.28**	.20**	.21**	.21	-
Concentration	.13	.13*	.37**	.14*	.15	.17	-
Elaboration	.09	-.00	.09	.10	-.14	.22	-
Graphic Study							
Aids	.10	-.03	-.05	.13*	-.01	-.16	-
Group Study	-.10	-.03	.04	-.07	-.11	-.01	-
Mastery Beliefs	.16*	.12	-.04	.11*	-.00	-.01	-
Memorization	.10	.07	.25**	.24**	-.01	.19	-
Motivation	.18*	.04	.18*	.18**	.16*	.06	-
Organization	.07	-.10	.02	.11	-.15	.14	-
Questioning	.05	.08	.35**	.17**	.12	.17	-
Review	.10	-.00	.15	.10	-.00	.19	-
Self-Monitoring	.10	-.03	.12	.16**	.11	.21	-
Study Resource							
Management	.03	-.13*	-.01	.04	.02	.21	-
Test Anticipation	.09	.06	.12	.11	.10	.25*	-
Test Strategy	-.07	-.09	-.13	-.05	-.16*	-.13	-

<sup>a</sup>Test scores were available only for beginning course segment.

\* $p < .05$ . \*\* $p < .01$ .

tion, Memorization, and Motivation. These study factors should receive the greatest attention in any study factors training program for technical training schools, especially those schools related to electrical technology or electronics. Time permitting, Anxiety reduction and Mastery Beliefs should be given training consideration. However, because the results obtained from this study are based on correlations, we can only suggest changes to training; further experimental studies are needed to confirm the observed relationships.

The fact that the same factors showed up across schools suggests that all schools similar to those in this study might benefit from the same training. On the other hand, there were differences across schools. Time permitting, a school administrator should consider giving the SFS to his or her own students and using the results to determine the study factors most appropriate for training.

The greatest number of significant correlations between study factors and performance occurred in the early segments. Two notable exceptions to this general rule were Questioning and Test Anticipation. Each of these factors may be affected by experience with instructors. Students may be able to anticipate test questions effectively only after becoming familiar with the

TABLE 4  
Partial Correlations Between Study Factor Scales and School Performance for  
the Third Segment of the Course

Study Factor	School						
	A	B	C	D	E	F	G
Anxiety	-.01	-.10	-.01	-.08	-.12	-.08	-
Competition	.18	.07	.37**	.08	.19	.14	-
Concentration	.21*	.15*	.29**	.22**	.12	.12	-
Elaboration	-.04	.13	.19*	.11	-.00	.03	-
Graphic Study							
Aids	.05	.03	.09	.08	-.15	.12	-
Group Study	-.02	.07	.02	-.07	.17	-.07	-
Master, Beliefs	.11	.12	.24*	.07	.24*	-.09	-
Memorization	.08	.11	.37**	.19**	-.10	.21*	-
Motivation	.12	.07	.22*	.11	.02	.19	-
Organization	-.06	.03	.11	.06	-.04	.15	-
Questioning	.02	.20**	.33**	.21**	.12	.12	-
Review	-.03	.07	.21*	.08	-.01	.16	-
Self-Monitoring	.02	-.03	.07	.06	-.08	.04	-
Study Resource							
Management	.10	-.05	.07	.02	.02	.02	-
Test Anticipation	.10	.17*	.26**	.00	-.22*	.01	-
Test Strategy	.01	-.02	-.01	-.05	-.11	-.08	-

\*Test scores were available only for beginning course segment.

\* $p < .05$ . \*\* $p < .01$ .

TABLE 5  
Number of Significant Correlations and Study Factors Per School

	School						
	A	B	C	D	E	F	G
Number of significant correlations per school	6	11	18	25	11	8	8
Number of significant study factors per school	5	8	11	14	9	7	8

types of test questions that the instructor asks. Similarly, students may become more relaxed about asking questions as they become more familiar with the instructor. This possibility is supported by the fact that Anxiety becomes a nonsignificant factor late in the course.

There are several possible reasons for the general decline in significant factors in the later portions of courses. Affective factors such as Anxiety and Motivation might be expected to be more important at the start of a course. Toward the end of a course, Anxiety may be reduced by familiarity and success, and students with low Motivation may have attrited. Another

possibility is that differences in the way that students respond to the SFS are reduced by attrition during the course. Those students remaining in the course may be more homogeneous with respect to their attitudes and the study skills they employ. A third possibility is that the effectiveness of study factor usage varies with course content and that study skills have a greater impact on the early segments of electrical technology and electronics courses, which typically emphasize basic theory and mathematics skills. Relative contributions of course and student variables in affecting study factors must be determined by further research.

Anxiety and Test Strategy showed consistently negative correlations with test performance. For the Anxiety scale, a negative correlation with test performance was expected. However, a negative correlation for Test Strategy and performance is counterintuitive, and a revision of the Test Strategy scale is indicated. The Group Study factor showed only one correlation, which was negative, and also should be revised.

School D had significant correlations with achievement in all but two of the study factors. Schools C and D had the highest number of significant correlations and the highest number of significant study factors. These schools are electronics schools in Navy ratings that traditionally have had problems with attrition or setbacks. Administrators in these schools should consider providing training in some additional study factors beyond those showing up across most of the schools.

The more metacognitively oriented study factors—Self-Monitoring, Organization, Review, and Elaboration—had few significant correlations with test performance in very few schools. This might be explained by the fact that all written tests used in these Navy technical schools were multiple choice, which may not have required these skills. It has been shown that, for multiple-choice tests, networking (a technique for organizing learning materials) was not successful (Dansereau et al., 1979). Casteñeda (cited in Pintrich, Cross, Kozma, & McKeachie, 1986) found deeper processing strategies to be less effective than repetition or grouping concepts for dealing with well-structured, technical text. On the other hand, concentration management, which involved self-initiated relaxation and positive self-talk, had a positive effect for multiple-choice tests (Dansereau, 1985).

The next step in this program would be to design and administer study factors training for the most significant factors to determine if this improves test scores in a course.

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